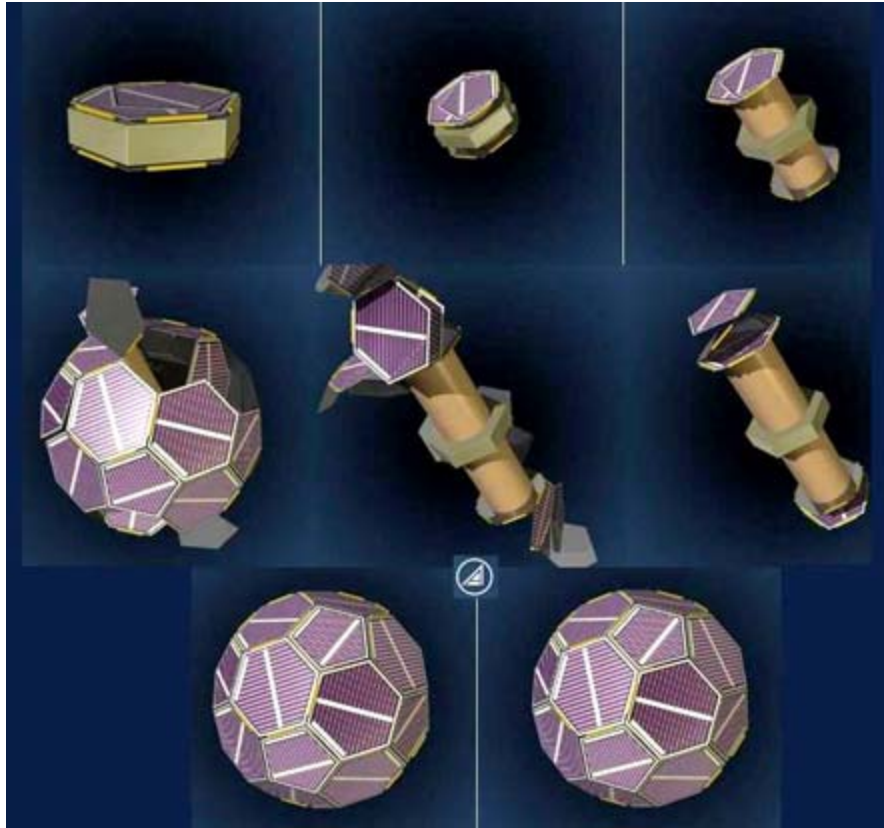


Multifunctional Inflatable Structure Being Developed for the PowerSphere Concept

NASA has funded a collaborative team of The Aerospace Corporation, ILC Dover, Lockheed Martin, and NASA Glenn Research Center to develop the Multifunctional Inflatable Structure (MIS) for a "PowerSphere" concept through a NASA Research Announcement. This power system concept has several advantages, including a high collection area, low weight and stowage volume, and the elimination of all solar array pointing mechanisms. The current 3-year effort will culminate with the fabrication and testing of a fully functional engineering development unit.

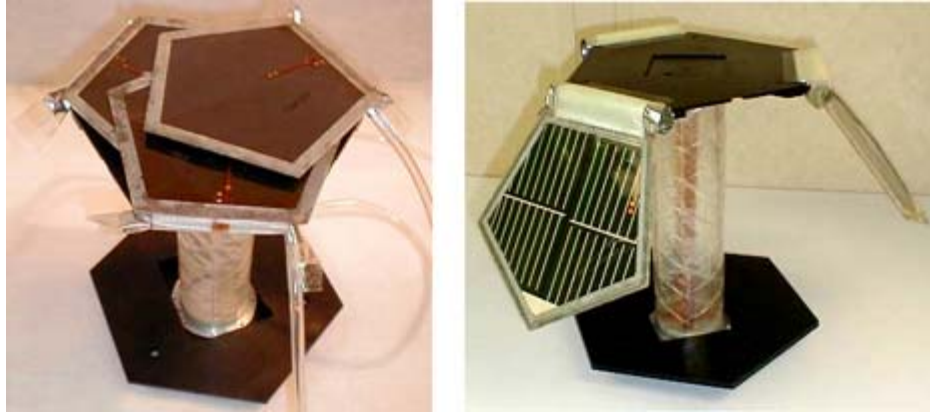
The baseline design of the Power-Sphere consists of two opposing semispherical domes connected to a central spacecraft. Each semispherical dome consists of hexagonal and pentagonal solar cell panels that together form a geodetic sphere. Inflatable ultraviolet (UV) rigidizable tubular hinges between the solar cell panels and UV rigidizable isogrid center columns with imbedded flex circuitry form the MIS. The reference configuration for the PowerSphere is a 0.6-m-diameter (fully deployed) spacecraft with a total mass budget of 4 kg (1 kg for PowerSphere, 3 kg for spacecraft) capable of producing 29 W of electricity with 10-percent-efficient thin-film solar cells. In a stowed configuration, the solar cell panels will be folded sequentially to the outside of the instrument decks. The center column will be z-folded between the instrument decks and the spacecraft housing for packaging. The instrument panel will secure the z-folded stack with launch ties. After launch, once the release tie is triggered, the center column and hinge tubes will inflate and be rigidized in their final configurations by ultraviolet radiation. The overall PowerSphere deployment sequence is shown pictorially in the following illustration.



PowerSphere concept.

Long description. PowerSphere shown in its stowed configuration, step-by-step deployment sequence, and final deployed configuration. In the stowed reference configuration, the shape is that of a hexagon approximately 7 inches wide by 4 inches thick. Once fully deployed and rigidized, the reference PowerSphere is a 24-inch sphere composed of hexagonal and pentagonal thin-film solar cells. The spacecraft body can be seen in the middle of the two hemispheres.

The PowerSphere MIS component technologies and system-level concept have matured sufficiently to begin engineering development unit fabrication in fiscal years 2003 and 2004 and testing in fiscal year 2004. Significant technology advances in thin-film photovoltaics, thin-film solar array flex circuitry, inflatable deployment systems, UV-rigidizable structures, coatings to protect polymer structures from electrostatic discharge and atomic oxygen, and distributed power management and distribution have been made through the second year of the overall 3-year effort. For example, the following photographs show prototype thin-film panel deployment tests recently performed at ILC Dover.



Left: Deployment test of thin-film panels (stowed). Right: Deployment test of thin-film panels (deployed).

Long description. Left: PowerSphere test article (column, end cap, and three thin-film panels) shown in a stowed configuration prior to deployment test. Right: PowerSphere test article (column, end cap and three thin-film panels) shown in a deployed configuration after the panel hinges are inflated.

Potential NASA applications for the PowerSphere include Earth magnetotail surveys, solar flotilla missions, planetary protection, sample return missions, multiplatform planet surface science, and formation flying interferometric astronomy science missions. Follow-on efforts also are being proposed to further advance the PowerSphere technology readiness levels for these types of potential spaceflight demonstrations by incorporating a number of key power systems technologies.

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